

AMENDMENT

U.S. Appln. No. 10/765,931

REMARKS

In paragraph 5 on page 3 of the Office Action, the Examiner rejects Claims 2-4 and 8-12 under 35 U.S.C. § 103 as being unpatentable over Sakuyama (JP2002-334895) in view of Amita et al (US2002/0046627).

The Examiner admits that Sakuyama does not teach or suggest "a solder precipitating composition" as recited in Claims 8 and 9 of the present application. However, the Examiner contends that Amita et al discloses a solder deposition method containing the steps of supplying a solder precipitating composition 10 to the substrate 12.

For the following reasons, Applicants respectfully traverse the Examiner's rejection.

Amita et al does not disclose a "precipitating solder". That is, Amita et al relates to a solder powder, a flux, and a solder paste, which have excellent storage stability and ensure excellent properties in and after reflow. Amita et al further relates to a soldering method using the solder paste; a soldered circuit board, and a soldered joint product for electronic parts (at page 1, paragraph 0003 thereof). The flux for the solder paste used therein comprises an organic acid component consisting of an organic acid ester and an ester decomposer catalyst, an organic halogen compound, a reducing agent and a resin component (see the Abstract thereof). The organic acid component consisting of organic acid ester and ester decomposer catalyst in the flux component effectively removes oxide of the metal surface of the circuit board and oxide of the solder powder during the reflow process (see page 5, paragraph 0076

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thereof). A reducing agent and an organic halogen compound which improves the storage stability of a solder paste and reflow property are also used (see page 5, paragraph 0077 thereof).

Amita et al merely discloses in page 4, paragraph 0063, a metal composition for solder powder which can be used in a solder paste. Anita et al, however, does not teach or suggest that the above metal composition is used for a precipitated solder. The solder paste which Amita et al discloses forms a solder layer only by melting and combining with a solder alloy in a paste.

On the other hand, in the solder precipitating composition of the present invention, a solder alloy is chemically precipitated through a substitution reaction of tin powder with a complex of silver ion or copper ion, or reaction of tin powder with a metal salt selected from lead, copper and silver.

In Amita et al, azoles (see page 8, paragraph 0115 therein) are added in order to prevent the circuit copper from rusting, and do not consist as a complex of silver ion or copper ion, as claimed in the present application. That is, by only adding azoles to a flux, Amita et al does not form a complex by reacting with a metal composition of solder powder.

In the present invention, azoles are used in the form of a complex of silver ion or copper ion (see Claim 8). This complex is used as a supply source for silver or copper in precipitating a solder.

As mentioned above, the solder composition used in Claims 8 and 9 of the present application is a precipitating type, i.e.,

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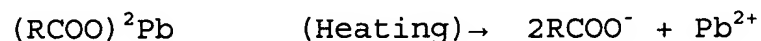
such is not a solder paste, which is disclosed in Sakuyama and Amita et al.

Precipitation of a solder by a precipitating solder composition is achieved by a substitution reaction utilizing a difference of ionization tendency between metals. That is, by reacting a salt or a complex of metal having a smaller ionization tendency (in the case of the present application, silver, copper, lead) with a metal powder having a larger ionization tendency than the above metals (in case of the present application, tin), a metal having a smaller ionization tendency (in case of the present application, silver, copper, lead) is precipitated. The precipitated metal is diffused in the tin metal existing excessively, and forms an alloy. As a result, a solder can be precisely supplied into a conductor pattern having a fine pitch.

The solder precipitating composition used in present Claim 9, which contains tin powder and a salt of at least one metal selected from lead, copper and silver, may be known (see page 2, lines 15-23, of the present application). The precipitating mechanism of the solder precipitating composition comprising tin powder and an organic acid lead salt is considered as follows.

[Solder Alloy Forming Process]

Step 1: Dissociation of an organic acid lead salt



Step 2: Substitution of lead ions with tin metal



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Step 3: Diffusion of lead reduced and precipitated
and excess tin metal



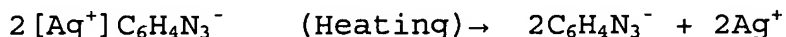
Step 4: Formation of an organic acid tin salt



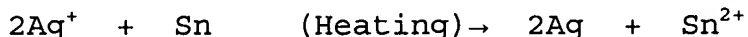
With regard to the solder precipitating composition used in the Claim 8, which uses a complex, for example, the precipitating mechanism of the solder precipitating composition comprising tin powder and a benzotriazole complex of silver ions is considered as follows.

[Solder Alloy Forming Process]

Step 1: Dissociation of silver complex



Step 2: Substitution of silver ions with tin metal



Step 3: Diffusion of silver reduced and precipitated
and excess tin metal



Step 4: Formation of tin complex



* $\text{C}_6\text{H}_4\text{N}_3^-$ shows an anion of benzotriazole.

In the present application, it is taught that "the use of such solder precipitating composition enables to form bumps precisely on electrodes of fine pitch substrates, and also prevent occurrence of voids as in the case of using a solder paste. With a method of forming bumps using a solder precipitating composition, it is however, difficult to form bumps having a desired height in a single deposition operation. This method therefore often requires at least two deposition

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operations" (at page 2, line 24 to page 3, line 4 of the present application).

More specifically, when an ordinary solder paste is used, it is filled in an open part of a solder resist film, and after being heated and melted, the desired spherical bump can be obtained. However, when a solder precipitating composition is used, even if the same amount as a solder paste is applied, it is difficult to form a bump in the same height. This is because the composition contains an excessive amount of tin powder and organic acid salt, which does not consist of a solder alloy. The above-mentioned excess materials are discharged as an organic acid salt and a complex.

"Accordingly, it is an advantage of the present invention to provide a solder deposition method that can deposit precisely and easily solder having a desired height (film thickness), and a solder bump forming method using the solder deposition method.

It is other advantage of the present invention to provide a solder deposition method that can prevent occurrence of voids, and a solder bump forming method using this solder deposition method." (See page 3, lines 6-11 of the present application.)

Thus, in Claims 8 and 9, after forming a dam around an electrode on a substrate, a solder precipitating composition is applied to said substrate. As a result, the following effect can be obtained; "This enables to prevent occurrence of voids, and also deposit precisely solder (e.g., solder bump) having a desired height in a single deposition operation. This improves joint strength when electronic parts are connected to a substrate by using solder, thus leading to high joint

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reliability" (see page 3, lines 21-25, of the present application).

As it is clear from the above explanation, the present invention can unexpectedly solve the problems by using "a solder precipitating composition". On the contrary, Sakuyama and Amita et al do not disclose "a solder precipitating composition", i.e., such only disclose an ordinary "solder paste".

Furthermore, Amita et al discloses use of azole for preventing the circuit copper from corrosion. However, the azoles in the present application are used as a complex of silver ion and copper ion, and the above complex becomes a supply source for silver or copper in precipitating a solder.

Accordingly, Applicants respectfully submit that the present invention is not taught or suggested in Sakuyama alone or when combined with the teachings of Amita et al, and thus request withdrawal of the Examiner's rejection.

In view of the amendments to the claims and the arguments set forth above, reexamination, reconsideration and allowance are respectfully requested.

The Examiner is invited to contact the undersigned at his Washington telephone number on any questions which might arise.

Respectfully submitted,

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